Executive Office of Environmental Affairs

Massachusetts Office of Technical Assistance

POWDER COATING

OTA Technology Fact Sheet

INTRODUCTION

Powder coating technology is successfully used in many industries as a substitute for solvent-based painting. This "dry paint" application process does not require a solvent. The powder is essentially a mixture of finely ground particles of pigment and resin that is electro-statically charged as it is sprayed onto a surface. The surface is then cured to set the coating.

Product Quality and Versatility

The powder coating process produces a high-quality, durable, corrosion-resistant coating. Color selection is virtually unlimited with high and low gloss, metallic, and clear finishes available. In addition, colors stay bright and vibrant for a longer period of time. Texture selections range from smooth surfaces to wrinkle or matte finishes to rough textures designed for hiding surface imperfections. Powder coating is a proven technology for automobiles, hardware, and general industrial applications as a substitute for solvent-based paints. The quality of the coating is equal, if not superior, to that of standard paint applications, with either equivalent or lower costs per item coated.

Economic Comparison

Operating Efficiency

Powder coating allows for faster line speeds because drying or flash-off time is not required. Even with greater line speeds, it is uncommon for powder coating systems to have drips, runs, or sags. If improper coating is found before curing, the powder can be removed with an air gun and re-applied. Powder overspray can be reclaimed and reused, although with proper equipment set up well over 90% spray efficiency is achieved.

Environmental Benefits

While liquid finishes contain solvents that have pollutants known as volatile organic compounds (VOCs) that are released into the atmosphere, powder coating does not because it contains no solvents. Thus, there is no longer a need for finishers to buy costly air pollution control equipment. Also, powder overspray can be reused, unlike paint that is wasted. Paint wastes may be considered toxic wastes, which require special handling and disposal.

Health and Safety Impacts

Since there are no solvents involved in the powder coating process, toxicity and odor are reduced and a lower level of protective equipment may be suitable. This may have an added benefit of lower insurance costs for a company.

Energy Savings

Depending on the size of the operation and the equipment used to apply and dry liquid paint, a company may encounter some energy savings by converting to a powder coating process.

Labor Efficiency

Powder coating requires less skill to operate than a liquid paint system. The powder is ready to use, and requires no mixing or thinning. Also, viscosity and pH do not have to be monitored.

Process Description

Pre-Treatment

Parts to be powder coated are pre-treated to ensure that the surface to be coated is clean and free of any contaminants. The pre-treatment process is normally conducted in a series of spray chambers where alkaline cleaners, iron or zinc phosphate conversion coatings, and rinses are applied. This process adds corrosion protection and improves coating adhesion.

Standard Process

Powder coating works on the principle that opposite charges attract. The powder is fed from a reservoir through a spray gun where the powder gains a low amperage, high-voltage positive charge. The parts to be painted are electrically grounded so that the positively charged powder particles are strongly attracted to the surface. The excess powder can be collected and reused. The powder coated part is then pulled through an oven where the powder melts and fuses into a smooth coating.

Fluidized Bed

Fluidized bed is another way to perform powder coating. Preheated metal parts (at 500° F) are dipped into the powder bed, and the powder melts on contact. This process is used mainly for thermoplastic coating.

Ultra Violet Light (UV) Curing

The curing of UV curable powder coating typically consists of two steps. First, the powder coating is melted with infrared (IR) radiation or a combination of IR and convection heating. Second, the coating is cured with UV light while the film is still warm.

UV curable powder coatings are opening doors to new markets and providing commercially viable alternatives to liquid and waterborne finishes. For instance, UV technology expands powder coating applicability beyond metal and medium-density fiberboard substrates to include paper substrates, such as cardboard and wallpaper. By using a UV curable coating, it is possible to first assemble the component with temperature-sensitive parts, such as seals or plastic parts, before coating the entire object. In many cases it can lower the handling costs and rejection rates considerably.

Powder Coating Resins

There are two major classes of powder coating resins: thermosets and thermoplastics.

Thermoset Resins

Thermoset resins cross link to form a permanent film that withstands heat and cannot be melted again. Thermoset resins are characterized by their excellent adhesion to metal. They are a one-coat system and do not require a primer. The five basic families of thermoset resins are epoxies, hybrids, urethane polyesters, acrylics, and triglycidyl isocyanurate polyesters (TGIC). Thermoset resins are used on items ranging from appliances to automotive parts to lawn and garden equipment to sporting goods. Today, approximately 90% of all powder coating formulations are based on thermosets.

Thermoplastic Resins

Thermoplastic resins form a coating, but do not undergo a change in molecular structure. These resins can be re-melted after they have been applied. Thermoplastic resins are used mainly in functional coatings, such as the thick, protective coating on dishwasher trays. Examples of thermoplastic resins used in powder coating are polyethylene, polypropylene, nylon, polyvinyl chloride (PVC) and thermoplastic polyester.

Advantages & Disadvantages

Powder coating produces a durable, high quality finish with good corrosion resistance. However, some ingredients, such as pigments and curing agents, may present skin contact or dust inhalation hazards to workers. These hazards can be easily avoided by standard protective equipment, like masks, gloves and hats. Another concern is the pH of and accumulation of oil, grease, and metals (from the use of zinc phosphate in "high end" applications) in the wastewater from the pre-treatment process. However, the wastewater treatment process is usually a simple pH adjustment and flocculation.

There are other advantages and disadvantages of powder coating in the table below.

Advantages:	**Disadvantages:**
• No solvent, reduced toxicity and odor	• Powder manufacturers can not make small quantities
• Over spray can be reused (up to 98%)	• Control of texture, size, and distribution limited
• Proven, available technology	• Enhances Faraday cage effect – a phenomenon by which charged particles are prevented from entering recessed areas, and may cause powder clumping
• Low material costs	• Difficult to match for repair and to strip
• No chemical clean-up	• May require pre-treatment of wastewater
• Easy, simple, fast	
• No hazardous overspray, waste sludge, or hazardous waste	
• Little operator expertise required	
• Energy savings	
• Lack of fumes	
• Minimum contamination of clothing	

For a list of Massachusetts companies that use powder coating in their operations or for more information on powder coating please contact the Office of Technical Assistance at 617-626-1060.

This fact sheet is one in a series prepared by the Office of Technical Assistance (OTA), a branch of the Massachusetts Executive Office of Environmental Affairs. OTA's mission is to assist Massachusetts facilities with reducing their use of toxic chemicals and/or the generation of toxic manufacturing byproducts. Mention of any particular equipment or proprietary technology does not represent an endorsement of these products by the Commonwealth of Massachusetts. This information is available in alternate formats upon request. OTA's **non-regulatory** services are available at **no charge** to Massachusetts businesses and institutions that use toxics. For further information about this or other case studies, or about OTA's technical assistance services, contact:

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